Hillside House Preliminary Drainage Report (w/o attachments)

Penfield & Smith

January 20, 2009

Calculations & Plans on File 630 Garden Street

ATTACHMENT D

HILLSIDE HOUSE
Preliminary Drainage Report

Santa Barbara, California

January 20, 2009

CLIENT: Bermant Development Company

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WORK ORDER NO.: 15778.01

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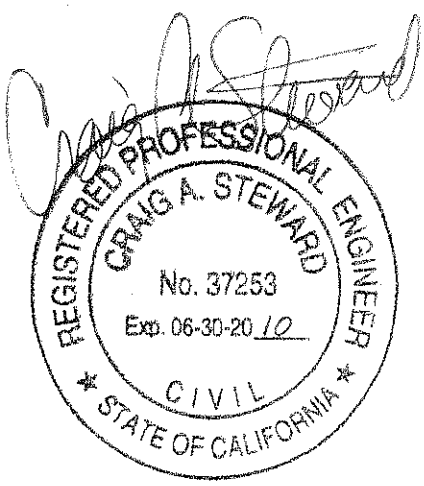
PROJECT ENGINEER: Craig A. Steward, P.E.



PURPOSE OF REPORT

The purpose of this report is to outline the approach to dealing with drainage issues from the proposed Hillside House Development and to provide details and selection criteria for the drainage devices proposed for use. The issues addressed in this report include:

- Flooding and flood safety
- Pre-development and post-development drainage flows
- Storm water detention
- On-site and off-site drainage improvements
- Overland escape

LOCATION

Hillside House is located west of the intersection of Las Positas Road and Veronica Springs Road at Assessor's Parcel Number 047-010-39. Arroyo Burro Creek crosses the property. The proposed project is situated north of Arroyo Burro Creek and east of Veronica Springs Road. See Figure A.

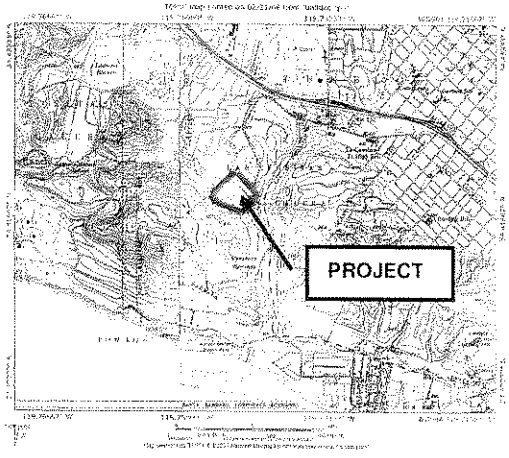


Figure A - Vicinity Map

BACKGROUND

The 23.72-acre Hillside House property currently includes approximately 114,500 sq. ft. of impermeable surface area (2.63 acres), in the form of buildings, driveways, parking areas, and other hardscape features. The remainder of the property is undeveloped. There are 12 existing structures at Hillside House, including those directly serving Hillside House (33,866 sq. ft.), those being used (or previously used) by non-profit organizations unaffiliated with Hillside House (7,543 sq. ft.), and abandoned structures previously moved to the Hillside House property (6,445 sq. ft.). With the exception of Harmony House, all of these facilities will be demolished as part of the project.

Under the current proposal, 33 multi-family buildings will be developed, containing a total of 121 residential units. One of these buildings will be Harmony House, which will be relocated and rehabilitated for modern use. In addition, the project will include 1 administration building, and 1 detached garage building. Hillside House will have a

combination license (ICF/DD-H (Habilitative) and ICF/DD-N (Nursing)). Ten (10) of the proposed buildings (Buildings 6, 10, 14, 17, 20, 22, 24, 26, 28, and 31) will include special-needs units for Hillside House clients on the ground floor, and Housing Authority rental units and inclusionary residences above.

Hillside House is located in lower reaches of Arroyo Burro Creek. Based on the data shown on the latest Flood Insurance Rate Map[1] the main creek flow adjacent to the project is contained well within the natural banks of the creek. See Figure B. 100-year

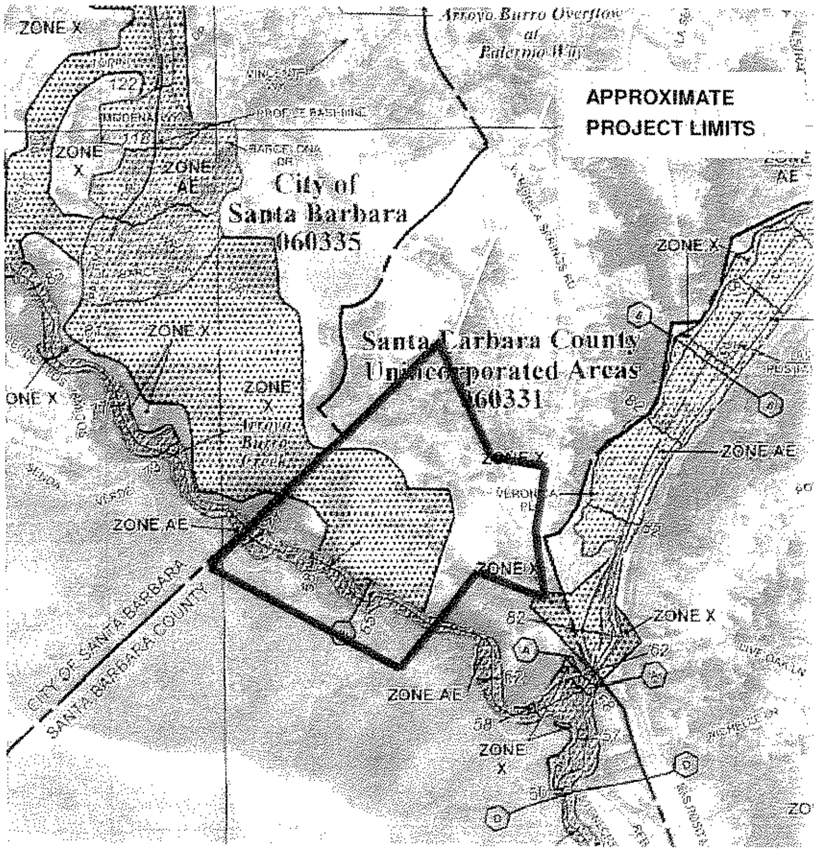


Figure B - FIRM Map

water surface elevations in the creek crossing the project range from approximately 60.5 feet NAVD88 to 73.5 NAVD88. Creek bank elevations in the same area range from elevation 84 NAVD88 to 91 NAVD88.

During a 100-year event, shallow overflow (depth < 1 foot) from a break-out originating upstream of the US Route 101 passes over the Union Pacific Railroad tracks and is

[1] Flood Insurance Rate Map, Santa Barbara County, California and Incorporated Areas, Panel 1386 of 1835, effective September 30, 2005.

distributed through the Hidden Valley housing subdivision. A portion of this overflow discharges from the cul-de-sac at Palermo Drive and sheet flows across the agricultural parcel immediately west of the project site and is shown to pass through the site. See Figure B.

The southerly banks of Arroyo Burro Creek consists of hillside which has been determined to be subject to potential ground movement[2]. The northerly creek banks are considered marginally stable, being steeper than would be expected for the natural angle of repose (2 horizontal to 1 vertical) for the site soils[3]. Erosion of the creek banks and the potential for landslides have been evaluated and appropriate setbacks from the creek banks have been recommended for site development[4]. These setbacks are indicated on the Preliminary Grading and Drainage Plans.

The northerly side of the site consists of a relatively flat shelf adjacent to the creek, backed by vegetated hillside further to the north. Development is proposed for a portion of the flat shelf.

The existing drainage path for flows passing through the project site is generally from north to south (with some discharge onto adjacent non-project parcels) over the steepened banks of the creek and then into the creek bottom. An existing 24" storm drain was constructed by Santa Barbara County Public Works, Department of Transportation in 1978[5]. It accepts some of the undeveloped storm flows from the northeasterly corner of the project parcel, channels them through a earthen ditch and into the storm drain near the southeasterly corner of the parcel. The storm drain accepts mainly flows from a small canyon which is in agricultural uses and large residential lots. The storm drain discharges to a lined portion of Las Positas Creek adjacent to Las Positas Road.

METHOD OF ANALYSIS

The residents of the proposed project will include a mix of mobile and partially mobile persons. The design of the site drainage features has taken this condition into consideration by providing larger drainage facilities than would normally be required. The standard design would require storm drains to be sized for a 25-year storm event. The proposed project has included storm drains and inlets designed for the 100-year

[2] Preliminary Geotechncial Report, Hillside House Development, Santa Barbara, California; prepared by Fugro West for Bermant Development Company; January 2006; p12.
[3] Ibid; p11.
[4] Ibid; pp 11, 13.
[5] Plans for the Construction of Veronica Springs Road from La Entrada to Las Positas Road; County Plan Nos. 103159 to 103164 (copy attached).

storm event. In addition, the site design also includes the setbacks from the creek recommended in the geotechnical report, diversion of off-site flows away from the project interior, and more conservative (higher) elevation to account for potential creek blockage. The design will also return overland creek flows back to Arroyo Burro Creek in a safe and non-erosive manner. The design is targeted to benefit the proposed project as well as the adjacent neighborhood.

Pre-Project Condition

The analysis was begun with a field visit to verify the pre-project site conditions and constraints. Based on the field visit, the watershed to the project site was defined and points of downstream discharge were determined. Land use and drainage facilities were identified. Using the Santa Barbara County Flood Control District Rational Method[6], the peak 100-year flow rates were determined for both the on-site and off-site watersheds. The land uses applied for the existing condition included open space (agriculture) and large lot subdivision as defined in the County computer program. The time of concentration was calculated using the TR-55 methodology which includes travel time for sheet flow, shallow concentrated flow and channel flow. The project site contribution to each discharge location from the project site was calculated.

The Arroyo Burro Creek conditions were determined for the 100-year flood conditions from the recent Arroyo Burro Watershed Restudy prepared by Penfield & Smith and approved by FEMA in 2005. Additional cross sections were cut to better define the water surface elevations through the project site.

Post-Project Conditions

The hydrology for the post-project conditions was developed using the same methods as in the Pre-Project except that in areas of development the land use were designated to be condominiums/apartments per the County hydrology computer program.

The next portion of the work required to properly design the project facilities was to determine how to handle the off-site storm flows. The areas of concern were:

- How to site and elevate residences (on the north side of Arroyo Burro Creek) to protect them should there be a major creek blockage due to earth movement on

[6] Program Rational XL published by Santa Barbara County Flood Control and Water Conservation District.

the southerly side of the Arroyo Burro Creek during a 100-year peak runoff event.

- How to handle flood flows to assure that they are discharged into the creek in a non-erosive manner and without increased damage to the natural creek banks.
- How to pass as much of the drainage flows from areas not proposed for development through the site without mixing them with on-site flows that would need to be treated for water quality concerns.
- What facilities are required to adequately drain on-site storm flows.
- What facilities are required for overland escape should proposed drainage facilities fail.
- What facilities are required to address storm water quality concerns.

Major Slope Failure in Arroyo Burro Creek with Concurrent 100-Year Flood

An extensive analysis of Arroyo Burro Creek was performed to set the appropriate building setbacks and finish floor elevations. Although the 100-year water surface elevations in the creek are well below the creek bank, there had been concern that a major movement of earth into the Arroyo Burro Creek channel could block flows and cause overland flooding. The likelihood of such concurrent events is remote and the actual failure scenario (partial blockage, full blockage, 100-year storm, 25-year storm, etc.) is unknown. The likelihood of a 100-year storm event in the creek is 1 percent in any one year. The likelihood of a major slope failure is unknown but has not occurred within the last 80 years at a minimum. The likelihood of the two events occurring simultaneously would be the product of the two frequencies (0.01 x unknown) which result in something that would have a statistical chance of occurrence of much less than 1 percent in any one year (100-year frequency).

It was assumed that the creek channel was blocked instantaneously up to the top of the creek banks and that a 100-year peak flow occurred simultaneously. The analysis made use of a modified FEMA HEC-RAS run and assumed that the overbanks on the proposed development side of the creek (northerly side) were blocked 100-percent to the toe of the proposed fill slope at the southern edge of the road. Using the calculated water surface from this analysis, the finish floors of the buildings were set at or above that water surface elevation.

Storm Drain Facilities Serving Non-Project Areas

Substantial non-project storm flows impinge and pass through the proposed developed site area from the north and from the west. Investigation of more detailed topography and preliminary analysis of the shallow flooding (less than 1 foot depth) shown on the FEMA map (see Figure B) was found to be too conservative and generally is discharged to Arroyo Burro Creek prior to reaching the project site. However, approximately 21.79 acres of non-project agriculturally developed land drains across the site from the west. Approximately 20.92 acres of non-project agriculturally developed and residentially developed (and not intermingled with on-site flows) drain across the site from the north.

It is proposed that flows from the west be collected in a shallow vegetated swale and be directed to an existing creek bank depression located at the southwestern corner of the project site. At this point it is anticipated that the diverted flows will be discharged above the 100-year water surface elevation in Arroyo Burro Creek through a substantial energy dissipation device and allowed to sheet flow into the natural creek channel. Water quality and erosion control design for this portion of the grading design has been prepared by Swanson Hydrology + Geomorphology. The purpose of this diversion is two-fold:

- Prevent the commingling of non-project storm water with on-site storm water (that must be treated) to the extent feasible.
- Minimize the flow of storm water over the creek banks within the proposed project area which increase the long-term bank stability by decreasing the saturation of bank soils and consequent weight of the bank soils.

It is proposed that the non-project storm water from the undeveloped area to the north be piped through the site and discharged to an extension of the existing headwall in Las Positas Creek southwest of the intersection of Las Positas Road and Veronica Springs Road. The existing headwall currently supports two (2) 60-inch diameter reinforced concrete pipes. The purpose of this proposed pipe is four-fold:

- Prevent the commingling of non-project storm water with project storm water that must be treated.
- Discharge non-project storm water and treated project storm water in a manner that will minimize riparian disturbance by releasing it to a location already suited for this purpose.
- Divert project site storm water runoff away from adjacent residences and buildings.

- Improve general drainage situation in the local neighborhood by minimizing ponded storm water in Veronica Springs Road and adjacent parcels.

Project Site Drainage Facilities

Proposed project site drainage facilities include storm drains within Veronica Place (the public site street parallel to Arroyo Burro Creek), minor storm drains tributary to the public site drains that are located within residential areas, and swales along the northerly site development area. Catch basins and inlets have not been sized nor detailed at this stage of the design. A system of swales and storm drains collect storm water and debris from the natural hillside to the north. In addition, a number of storm water quality best management practices (BMPs) are integrated into the site storm drainage system which include vegetated swales, bioretention, and permeable pavers. These BMPs are detailed in the Preliminary Storm Water Quality Report for the project.

Preliminary analysis of the storm drains and drainage swales has been calculated using Manning's equation. For storm drain systems modeled, a conservative analysis assuming full flow (pressure flow) has been provided. For most residential area storm drain systems, no detailed analysis has been provided at this point in the design. For swale design, a normal depth analysis has been provided for the most critical location (greatest amount of runoff at the mildest slope).

Storm water detention has been provided and detailed calculations are included in the Preliminary Water Quality Report.

Overland Escape

The first and primary approach to overland escape has been to design critical drainage facilities so that the need for overland escape is less likely. Therefore, all storm drains and storm drain inlets are designed to accommodate the 100-year peak runoff as opposed to the 25-year peak runoff normally used for design.

In addition, overland escape is provided by making the driveways and landscaped areas surrounding the residences lower than the residences. No detailed analysis of the driveways is provided at this time in the design. However, tributary areas to most driveways are small and are not likely to be a concern.

The public street (parallel to Arroyo Burro Creek) is designed so that if one inlet is blocked, flow ponds and overflows down to the next downstream inlet. Should the last

inlet be blocked, the overflow will discharge to the location it has historically – the southeasterly corner of the parcel.

Overland escape at the extreme westerly side of the project site will be to the existing improved creek bank depression that also accepts discharge from non-project and minor project site areas. Design plans for this swale were prepared by Swanson Hydrology + Geomorphology and are included in the Preliminary Grading and Drainage Plans.

Of greater concern is the overland escape pathway for storm drain receiving non-project flows from the northeast corner of the site. Although the inlet to this storm drain is proposed with a trash rack and considerable margin safety for inlet ponding, should the inlet or storm drain fail, storm flow is designed to overtop the headwall in a non-erosive manner and flow down Private Drive No. 1 which is immediately parallel to Veronica Springs Road. It is the intent of the design to not inundate adjacent residences. Preliminary normal depth analysis of the critical location (narrowest width and mildest slope) has been provided.

RESULTS

Detailed calculations and results are presented as attachments to this report. Exhibits depicting drainage areas (Exhibits 1 and 2), storm drain alignments and sizes (Exhibit 3) are also attached. The following is a brief summary of the results and pertain to storm drain and inlet sizing only. Pre-project and post-project flow comparison using a different methodology are included in the Preliminary Stormwater Water Quality Report.

Table 1 - Tributary Area Comparison

	Tributary Area, acres			
Location	**Pre-Project**	**Post-Project**	**Difference**	**Comment**
Over Creek Bank	29.2	2.6	-26.6	To Steep Banks
To Creek Bank Depression	1.6	22.0	20.4	
To APN 047-01-36, 37	5.5	0.2	-5.3	Adjacent Parcels
To Storm Drain	22.2	33.7	11.5	

Major Slope Failure in Arroyo Burro Creek with Concurrent 100-Year Flood

Results of a possible major slope failure in Arroyo Burro Creek are summarized in Table 3. The cross section locations are shown on Exhibit 4 attached to this report. Refer to Grading Plan for adopted finish floor elevations. The 100-year peak flow rate in this analysis was 5,710 cfs.

Table 2 - 100-Year Water Surface Elevations with Channel Filled

Cross Section	Min Ch El	W.S. Elev	Vel Chnl	Flow Area	Froude # Chl
	(ft)	(ft)	(ft/s)	(sq ft)	
7515	50.3	60.93	14.64	390	1
7765	49.76	65.06	3.76	1519.14	0.21
8075	84	87.46	9.77	624.46	0.93
8355	86	90.26	6.16	960.31	0.53
8492	86	90.81	5.61	1022.78	0.45
8708	89	91.97	8.99	677.07	0.92
9038	88.9	94.03	6.64	945.28	0.52

Storm Drain Facilities Serving Non-Project Areas

Drainage facilities receiving non-project impacted storm flows include a westerly diversion swale and an easterly storm drain. Exhibit 4 shows the location and proposed size of both of these facilities. Each is designed to pass the 100-year flow.

The westerly diversion swale is a vegetated swale which discharges into the existing creek bank depression adjacent to Arroyo Burro Creek. The diversion swale system accepts storm water mainly from the agricultural fields west of the project and is designed to filter the storm water. The system includes a sediment trap, a vegetated swale, headwall and storm drain to carry flows under the driveway and a erosion-protected and bio-enhanced swale discharging to Arroyo Burro Creek. This approach will divert storm water away from the current point of discharge over marginally stable banks and to a more acceptable entry point to Arroyo Burro Creek where the storm water will be slowed and spread for a non-erosive entry into the Arroyo Burro Creek.

Starting at the downstream end, the easterly storm drain (described from downstream to upstream) begins at a proposed extension of an existing headwall. The headwall currently receives flow from Las Positas Creek via two (2) 60" diameter storm drains. The proposed headwall improvements would consist of extending the headwall and

cutoff wall, and providing additional loose rock rip-rap to dissipate energy. The storm drain consists of a 42" reinforced concrete pipe (or its equivalent) in Veronica Springs Road up to a proposed junction with the existing 24" storm drain. At this point, discharge flows will be balanced between the two storm drains. The 42" reinforced concrete pipe continues to an on-site storm drain junction. From this point, the storm waters pass through a 36" reinforced concrete pipe to the upstream terminus of the storm drain at the northeast corner of the project. At this end of the storm drain, a headwall with a depressed inlet and debris rack[7] will be constructed. It is anticipated that the existing 18" storm drain from Veronica Springs Road will also be tied into the proposed headwall.

The easterly storm drain route in Veronica Springs Road passes through an area very congested with utilities. Since the depth of some of the utilities is unknown, final design may require some adjustment to grades, alignment or pipe sizes. Prior to beginning final design, the critical utility locations should be pot-holed and surveyed.

Project Site Drainage Facilities

Project site storm drain facilities include catch basins and inlets (not sized for this report), the storm drain within the public street (parallel to Arroyo Burro Creek), minor storm drains within the residential and driveway areas (also not generally sized at this time), and concrete v-ditch used to capture runoff from adjacent hillside slopes. All drainage facilities will be sized to accept a 100-year flow. The location of these facilities is shown on Exhibit 3. The size of the designed facilities is also shown.

The storm drains serving the public street (Veronica Place) range in size from 18" diameter to 36" diameter. The minor storm drains in residential areas are anticipated to be 12" diameter or smaller with the exception of the drain that accepts flows from the concrete v-ditches. This storm drain has been sized as a 24" diameter pipe and will pass a 100-year flow. The concrete v-ditches are 18" deep with 1½ : 1 side slopes. Calculations are included that indicate sufficient capacity at the minimum slope.

Overland Escape

Overland escape routes for residential on-site watersheds are provided by elevating the building floors above the surrounding ground and access routes. Overland escape for more substantial drainage features is provided within the streets or driveways.

[7] See APWS Standard Plan 361-0.

Calculations for the most critical location are attached. The location of overland escape points of discharge out of the project boundaries are shown on Exhibit 3.

The calculations for the critical location indicate that the overland escape for flows from a 100 percent blocked off-site drain can marginally be routed down the private driveway parallel to Veronica Springs Road. Final design of this area may require some minor adjustment to grades or landscape island locations.

Water quality calculations and methodologies are covered in a sister report submitted with this report.

CALCULATIONS AND ATTACHMENTS

- **Exhibits**
  - Exhibit 1 – Pre-Project Condition
  - Exhibit 2 – Post-Project Condition
  - Exhibit 3 – Storm Drain Locations
  - Exhibit 4 – Cross Section Locations
  - Exhibit 5 – Pre-Project Time of Concentration
  - Exhibit 6 – Post-Project Time of Concentration
- **Calculations**
  - Time of Concentrations Calculations
  - Pre-Project Hydrologic Calculations
  - Post-Project Hydrologic Calculations
  - Channel Capacity and Street Capacity Calculations
  - Storm Drain Flow Rates (without detention)
  - On-Site Storm Drain Analysis
- **Resource Documents**
  - Time of Concentration Data
  - Rainfall depth-duration data

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